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The Nordic Mobile Telephone System sets the stage for future mobile systems

ARTHUR CORNWELL

AT THE MOMENT, the Nordic Mobile Telephone (NMT) system is the only fully operational, large scale, trans-national mobile telephone system in the world. It was jointly developed by the national telecommunications administrations (PTTs) of Sweden, Norway, Denmark and Finland. The technology is freely available to any interested parties without payment of fees or royalties of any kind.

A short time ago, with the NMT 450 megahertz (MHz) system favorably impressing Ireland, Austria, Spain, the Benelux countries and, possibly, Italy, it appeared to be set fair toward creating a European standard. This was not to be. Competing systems like AMPS, MATS-E and NETZ-E, allied to the commercial approach being taken in countries such as the U.K., France, West Germany and the U.S. were not to be denied, and the emergence of a modified AMPS system in the U.K., designated TACS, marked the first check in the apparently irresistible march of NMT.

Since its inception in the latter half of 1981, NMT usage has increased at a high and steady rate. By the end of 1982 there were about 30,000 subscribers spread over an area of 500,000 square kilometers, an area equivalent to that of France or about twice that of England and Scotland. Accelerating at a rate of 3000 to 4000 subscribers a month during 1983, the 100,000th registration was expected during June of this year. This, from a population base of only 22 million people in the four countries, most of whom have been operating limited, manually-served mobile systems in the very high frequency (VHF) band since the early 1950s.

This photo shows a back seat extension installation of the Ericsson combined control unit and handset.

By the late 1960s the need for a fully automated system was apparent, and in 1969 the NMT working group was set up and given the task of drawing up a joint specification for a future system. Not surprisingly, in view of the time scale involved in working out an automatic system acceptable to all the Nordic countries, the first result was a new manual system in the 450 MHz band for use in Norway, Denmark and Sweden, while simultaneously Finland started a national VHF system. It was also decided to use a band in the 450 MHz range for the automatic system with the manual system channels transferred to the NMT as they were progressively taken out of service.

The basic requirements for a fully automatic system seem obvious in 1984, but this was the ambitious listing that emerged in 1970:

- The system should be capable of automatic setting up and charging of calls both to and from a mobile station.
- Conversation should be possible between a mobile station and a fixed telephone in any of the four countries.
- Conversation should be possible in any base station area or in whichever Nordic country a mobile subscriber happened to be.
- Conversation between two mobiles should be possible whether they were in the same base station area or in different areas even if these should be different Nordic countries.
- Subscriber capacity should be sufficient for a lengthy period both in respect of the number of radio channels and subscriber numbers.
- The use of a mobile telephone

Continued on page 55

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should, as far as possible, be similar to that of a fixed telephone network.

- The system should, if technically and economically possible, permit automatic paging of a mobile subscriber and recording of the base station area in which that subscriber happened to be.
- The reliability of number transmission should be sufficiently high to satisfy the requirements of automatic charging.
- In designing the system the greatest possible attention should be given to costs, particularly the costs of the mobile equipment.
- The design of the system should not necessitate any significant changes in the existing telephone networks.
- The system should offer the same facilities as are offered for fixed telephone subscribers and should allow for charging on the basis of facilities used.
- The system should ensure a subscriber's privacy of conversation in relation to other subscribers as far as possible.

The heart and brain of the system and the most technically complex element was to be the mobile telephone exchange, which would interface between the mobile system and the fixed telephone networks which had certain national differences. It would control all processing, system maintenance, charging and network management functions. The base stations, about 900 of them at full capacity, would link the line and radio transmission functions and consist of a number of transceiver modules, according to the traffic requirements, as well as control and supervisory equipment. A single transmitting antenna would be fed from multiple transmitters through the combined network. The mobile stations would be available in various forms such as vehicle units, hand portables and fixed coin operated units. Within this framework, certain special functions would need to be provided, such as roaming, hand-off and the development of the small cell technique to increase traffic capacity in high density urban areas.

Numbering and routing systems were defined and charging principles established on the basis of initial subscriber charges, subscription fee and call charges. Additionally, there would be special facilities available—and distinction between national and international calls, all of which required the establishment of a comprehensive signal framing system using hexadecimal digits. Such board technicalities now are accepted technology for cellular radio systems and need not be reviewed in detail; it is the concept and philosophy of the system which appear to be its strength.

Swedish PTT Director Tony Hagström (above, right) is using the NMT system while Bo Magnusson, head of mobile radio services at the Swedish PTT, watches. At right, the NMT system is being used in the archipelago of Stockholm.

In developing the system, the PTTs of the Scandinavian countries gave priority to the overriding need for a communication system that could keep pace with the requirements of the late 20th Century. It obviously generates sufficient profit to recoup investment, cover operating costs and finance expansion. However, since it is not a privately owned commercial operation, it does not have either to practice or display the more obsessive characteristics of such organizations. The fact that it is providing exactly the service that is required is implicit in its remarkable growth, as a result of which the system has to move to 900 MHz after 1985. This affords the opportunity for further improvements in certain performance characteristics, such as faster signaling, call set-up and hand-off procedures. The already superior frequency economy will be improved and sub-cell and cell-in-cell forms will be used to expand the system capacity whilst maintaining the proven NMT configuration.

Other efforts

Distinct from the Nordic PTTs, equipment suppliers to the system continue to spend huge sums on research and development. Typically, Mobira, Salo, Finland, has been involved since NMT was first con-

ceived and currently leads the market with about 19% of radiotelephone sales (Table 1). The company is also supplying quantities to the U.K. market. Ericsson, Stockholm, Sweden, holds a slightly smaller overall share but leads the market in Norway and Sweden, while Storno, Copenhagen, leads in Denmark. Total NMT sales in 1983 were 43,024 units.

Meanwhile, the Scandinavian PTTs continue to look ahead and have already formulated plans for a digital pan-European system for the 1990s. For this reason, it has been suggested that the present confusion and incompatibility within Europe may not be all that important. It was inevitable that either the U.K., France or Germany, or all three, would eventually have a deciding influence on the introduction of a European system. The French preference was for the drawing board ideal of the MATS-E system for which there is no product. West Germany wants the NETZ-E 450 MHz system, and the two of them look like agreeing eventually on a 900 MHz version of this.

Meanwhile the U.K. is going ahead with the TACS system, modified from the U.S. AMPS to such an extent that equipment is not interchangeable. Saudi Arabia and Korea have chosen NMT.

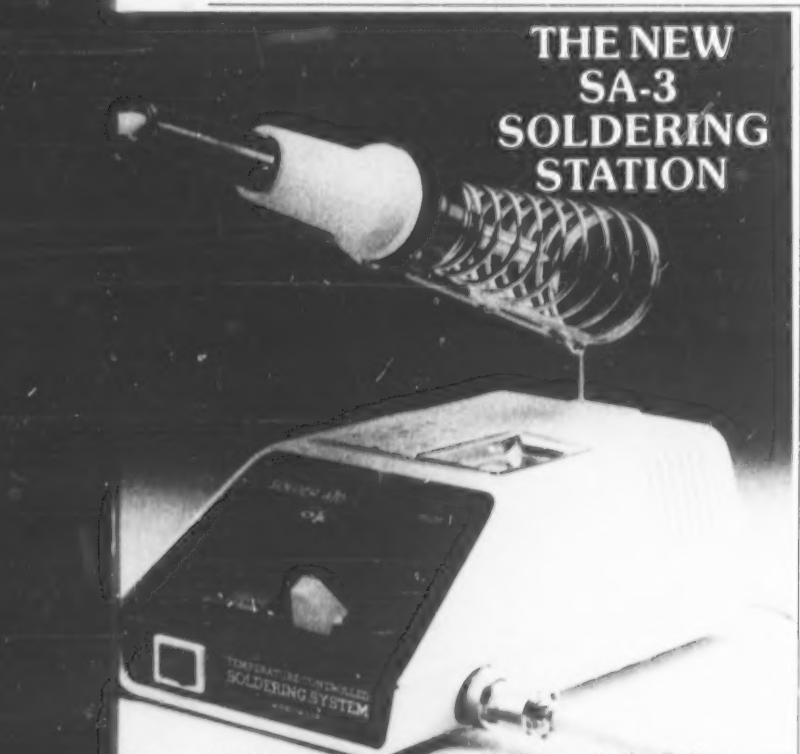
It seems that everyone now has an opportunity to go it alone and acquire useful operating experience before the dictates of the approaching 21st Century communication requirements eventually impose a unified international system or produces the technology which will marry any one system to another.

During this period, the NMT system will go to 900 MHz since the need is too pressing to wait for the experience of the only other current alternative—TACS. It is a sobering thought that even 16 years from now, market forces applying at the time may decide the 21st Century's system rather than experience and planned development. If there should still be a proliferation of systems, the quote of the millenium could well be: "Freedom of speech by all means—but this is ridiculous!" □

Table 1
Total sales and percentage of NMT radiotelephones

Brand	Finland	Norway	Sweden	Denmark
Mobira	3173 (54.2%)	1579 (12.7%)	2325 (14.5%)	1022 (11.7%)
Ericsson	619 (10.6%)	2100 (16.9%)	3479 (21.7%)	1327 (15.2%(
AP	577 (9.9%)	1788 (14.4%)	1331 (8.3%)	2060 (23.5%)
Siemens	370 (6.4%)	1800 (14.5%)	1571 (9.8%)	1459 (16.7%)
Panasonic	581 (10%)	1260 (10.2%)	2678 (16.7%)	17 (0.2%)
Storno	183 (3.1%)	907 (7.3%)	1267 (7.9%)	2130 (24.4%)
Motorola	114 (2%)	1428 (11.5%)	1443 (9%)	113 (1.3%)
NEC	171 (2.9%)	310 (2.5%)	1122 (7%)	480 (5.5%)
Mitsubishi	44 (0.8%)	559 (2.5%)	818 (5.1%)	52 (0.6%)
Simonsen	nil	683 (5.5%)	nil	nil
Dancall	nil	nil	nil	76 (0.8%)
Others	8 (0.1%)	nil	nil	nil
Total	**5840**	**12,414**	**16,034**	**8736**

(Source: Mobira News, May 1984 edition)



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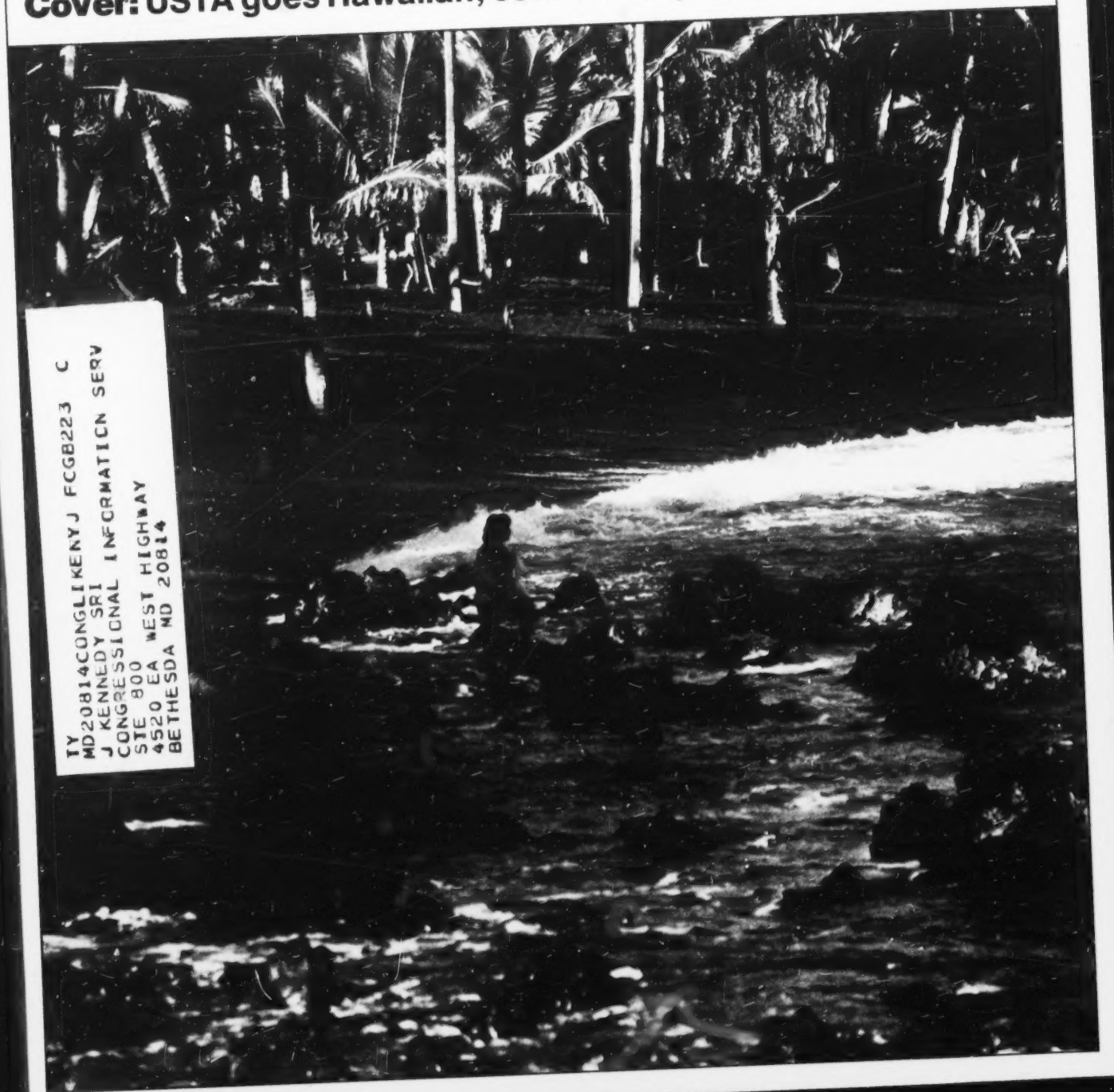

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Big spenders are spending more

NORMAN H. SEFTON and MARK V. MORAWIEC

AN INTERNATIONAL Communications Assn. (ICA) survey indicates a 13% annual increase in expenditures for telecommunications services as a percentage of sales and operating expenses.

An interesting trend has emerged regarding expenditures for telecommunications services according to the ICA survey. Other telecommunications associations also participated in the 1984 ICA survey, including the Southeastern Telecommunications Assn. (SETA), the Telecommunications Assn. (TCA), the Assn. of College and University Telecommunications Administrators (ACUTA), the Communications Managers Assn. (CMA) and the Chicago Industrial Communications Assn. (CMA).

In 1984 data was collected from 254 companies, universities, hospitals and government agencies; 23% of ICA's total membership was contacted. Data was combined into appropriate classes with an average of seven responses per category.

The survey requested information regarding sales, operating expenses and expenditures for telecommunications services. Tables 1 and 2, and Figures 1 and 2 present the results of the 1984 survey in addition to data obtained from a similar survey conducted by the ICA in 1981. The 1984 survey uses financial data from 1983 while the 1981 survey used 1980 data.

The computer services industry showed the telecommunications expense as the highest percentage of both sales and operating expenses with 6.64% and 7.19%, respectively. This is consistent with the 1981 survey, which also showed computer services greatly outdistancing its followers in both categories.

Many similarities exist between the results obtained this year and those from the 1981 survey. Dominating the next five rankings from each survey are office equipment/computers, electrical/electronics, airlines, and banks and bank holding companies.

Overall

An overall figure for telecommunications expense was calculated across all industries. This resulted in 0.74% of sales and 0.95% of operating expenses. Relating this to data from the 1981 survey shows a 45% and 46% increase in telecommunications expense as a percentage of sales and expenses, respectively. (The 1981 survey gave telecommunications expenses at 0.51% of sales and 0.65% of expenses.) This is an annualized 13.25% increase based on sales and 13.5% increase based on expenses. This demonstrates not only that companies are spending more money on telecommunications services, but this expense now is encompassing a higher percentage of their sales and operating expenses.

The surveys conducted 3 years apart illustrate two main points. First, there are several industries which continue to be the leaders in telecommunications expenditures in relation to their sales and operating expenses. Second, corporations, universities, hospitals and government collectively have demonstrated more than a 13% annual increase in the amount of money allocated to telecommunications as a percentage of their revenues and expenses. □

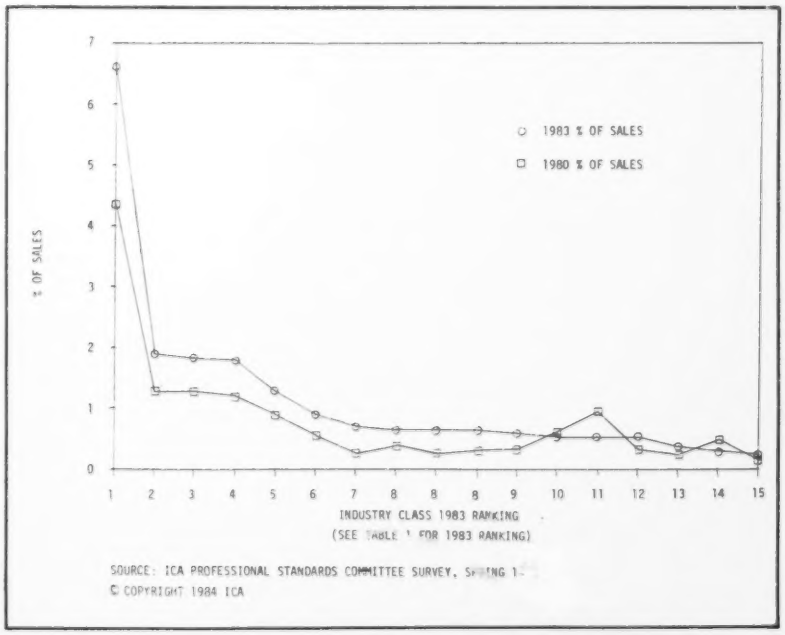

FIG. 1 *Telecommunications expense as a percentage of total corporate sales.*

Norman H. Sefton is Assistant Business Manager-Communications for Duke University, Durham, N.C., and a Board Member of the International Communications Assn. (ICA). *Mark V. Morawiec* is a Masters of Business Administration (MBA) Student at the Fuqua School of Business at Duke University. This article was adapted from one that appeared in the ICA Communique, August 1984, Vol. 38, No. 2. Copyright 1984, ICA. The ICA 1983 Telecommunications Expense Survey Final Report was prepared under the supervision of Norman Sefton with the assistance of the ICA Professional Standards Committee Members.

Table 1
Telecommunications expense % sales

1983 RANK	1980 RANK[1]	TYPE OF INDUSTRY	1983 % SALES	1980 % SALES
1	1	Computer Services	6.64	4.40
2	3	Office Equipment/Computers	1.89	1.30
3	3	Electrical/Electronics	1.84	1.30
4	4	Airlines	1.83	1.20
5	7	Transportation-Shipping & Rail	1.25	0.86
6	10	Conglomerates	0.85	0.58
7	23	Food Processing	0.70	0.25
8	13	Insurance	0.65	0.42
8	22	Metals/Mining/Steel	0.65	0.27
8	20	Textiles & Apparel	0.65	0.30
9	17	Manufacturing	0.62	0.36
10	9	Aerospace	0.57	0.61
11	6	Financial-Non Bank	0.56	0.98
12	19	Chemicals	0.55	0.34
13	21	Automotive	0.38	0.29
14	11	Utilities	0.34	0.53
15	24	Energy	0.23	0.18
		AVERAGE	1.19	0.83
		MEDIAN	0.65	0.58
		STD. DEVIATION	1.46	0.96

1. Ranking based on 26 categories appearing in 1980 survey results.

Source: ICA Professional Standards Committee Survey, Spring 1984.
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Table 2
Telecommunications expense % expenses

1983 RANK	1980 RANK[1]	TYPE OF INDUSTRY	1983 % EXPENSES	1980 % EXPENSES
1	1	Computer Services	7.19	6.20
2	*	Service Organizations	3.35	*
3	4	Banks & Bank Holding Companies	2.08	2.10
4	7	Office Equipment/Computers	1.98	1.60
5	6	Electrical/Electronics	1.97	1.70
6	8	Airlines	1.87	1.20
7	14	Conglomerates	1.47	0.66
8	9	Transportation-Shipping & Rail	1.39	0.96
9	8	Universities	1.27	1.20
10	*	Hospitals	1.16	*
11	23	Textiles & Apparel	0.96	0.35
12	13	Insurance	0.92	0.73
13	21	Food Processing	0.87	0.42
14	15	Government	0.80	0.64
14	16	Manufacturing	0.80	0.60
15	17	Metals/Mining/Steel	0.65	0.52
16	8	Financial-Non Bank	0.62	1.20
17	15	Aerospace	0.61	0.64
18	22	Chemicals	0.59	0.40
19	24	Automotive	0.52	0.30
20	11	Utilities	0.38	0.80
21	25	Energy	0.24	0.24
		AVERAGE	1.36	1.12
		MEDIAN	0.92	0.73
		STD. DEVIATION	1.45	1.26

1. Ranking based on 30 categories appearing in 1980 survey results.
*No data in survey.

Source: ICA Professional Standards Committee Survey, Spring 1984
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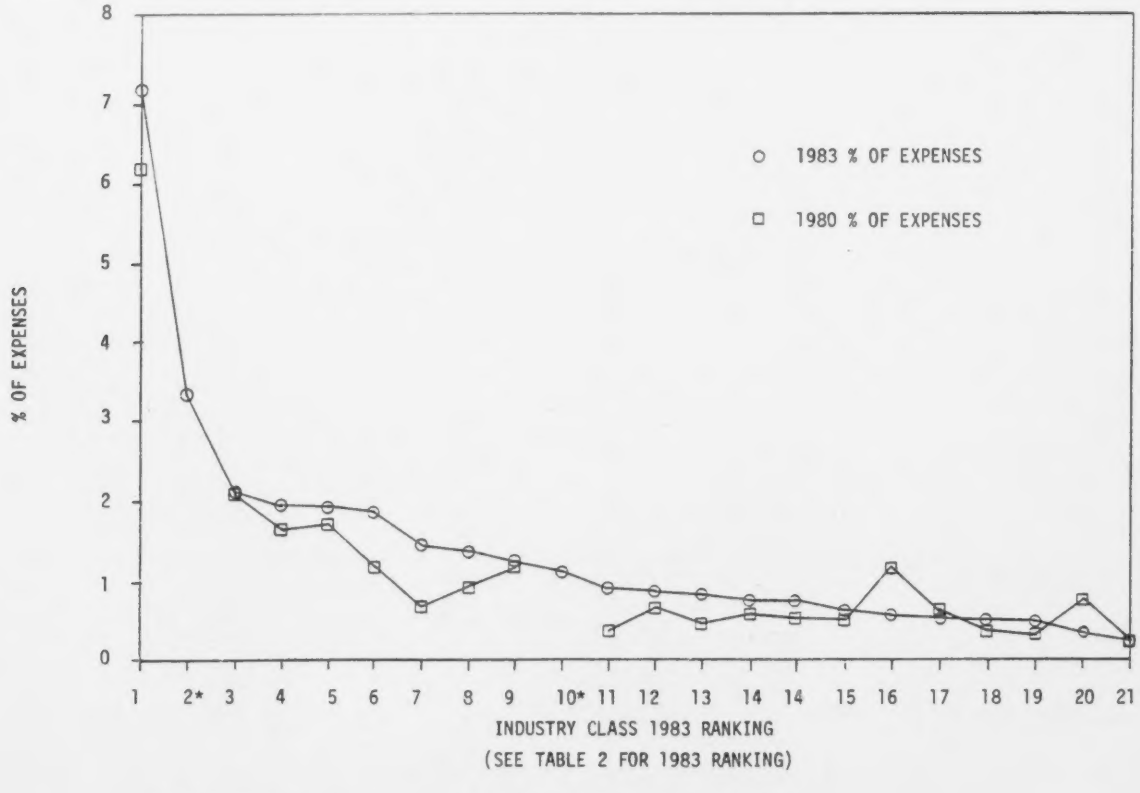
FIG. 2 *Telecommunications expense as a percentage of total corporate expenses.*



SOURCE: ICA PROFESSIONAL STANDARDS COMMITTEE SURVEY, SPRING 1984
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